



NDCEE

National Defense Center for Energy and Environment

Demonstration of Zero-Energy Housing (ZEH) Concepts at Army Installations

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DoD Executive Agent

Office of the
Assistant Secretary
of the Army
(Installations and
Environment)

The NDCEE is operated by:  *Concurrent Technologies Corporation*

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Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE MAY 2008		2. REPORT TYPE		3. DATES COVERED 00-00-2008 to 00-00-2008	
4. TITLE AND SUBTITLE Demonstration of Zero-Energy Housing (ZEH) Concepts at Army Installations				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) National Defense Center for Energy and Environment (NDCEE), Concurrent Technologies Corporation, 100 CTC Drive, Johnstown, PA, 15904				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 17	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Presentation Highlights

- ZEH and why the Army is interested
- NDCEE work with the Army
- Demonstration findings to date

Zero-Energy Housing

- Designed to maximize occupant well-being while minimizing energy requirements
- Combines energy-efficient technologies and construction techniques with renewable energy systems (e.g., photovoltaics)

$$\text{Energy Consumption}_{\text{house}} = \text{Energy Generation}_{\text{house}}$$

ZEH Drivers

- In FY06, 300,000 DoD homes used 11 trillion BTUs of electricity at a cost of \$254M
- Executive Order 13423, Energy Policy Act of 2005, and Army policy require more energy-efficient/less polluting buildings
- Energy efficiency leads to reduced electricity use and costs, increased energy security, reduced greenhouse gases, and potentially an improved living environment

Task Overview

- Evaluate the applicability, accuracy, and usefulness of energy modeling to predict energy consumption associated with baseline conditions and candidate energy-saving technologies.
- Evaluate ZEH-related technologies on their ability to cost-effectively reduce energy consumption in newly constructed and historic homes.



Working with Military Housing Developers/Managers

- Enabled by Residential Communities Initiative (RCI)
 - Objectives
 - Eliminate inadequate military housing
 - Eliminate deficit
 - Approach
 - Military Housing Privatization Initiative: 1996
 - Obtains private expertise/ capital to solve housing problems
 - Oversight
 - 50-year lease – all resources revert to Military at end of lease
 - Portfolio and Asset Management
- Equipment and construction costs provided by Army Hawaii Family Housing

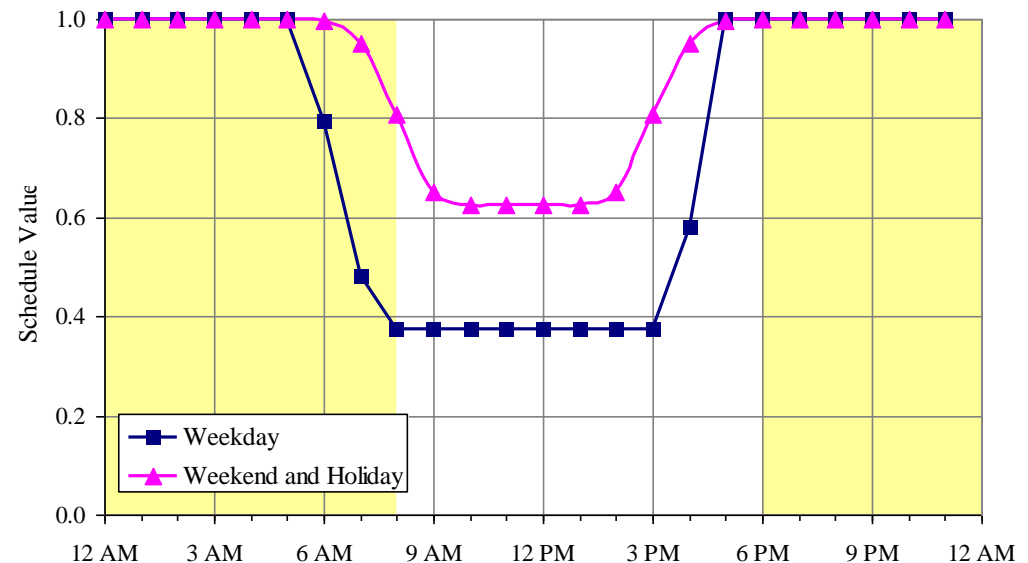
ZEH Concepts Demonstration Approach

- Identify technology integration opportunities within RCI developments to achieve zero (or near zero) energy homes
- Team with RCI development partners and coordinate with Army Installation Management Command to ensure success
- Conduct energy modeling and analysis to determine high-performance, cost-effective technology integration strategies
- Demonstrate and validate costs/benefits to include energy, cost, environmental, and operational performance

Energy Modeling via eQUEST

Computer-based tool that simulates a building's energy usage

- Optimize the building design
- Allow the design team to prioritize investment strategies



Occupancy Profile

Weather Data - Building Envelope -
Internal Gains - Schedules - Systems

Accomplishments

- Identified 14 low-cost technology integration strategies to improve energy efficiency for 7,900 new and renovated “historic” homes
- Conducted energy analysis using commercially available modeling software to evaluate alternative strategies
- AHFH is installing 3 technologies, and the NDCEE will monitor to demonstrate and validate performance
 - Radiant barrier in walls
 - Low absorptance house coating
 - Increased ventilation (solar attic fans)

Computer Simulation - Shading Study



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Preliminary Energy Modeling Results

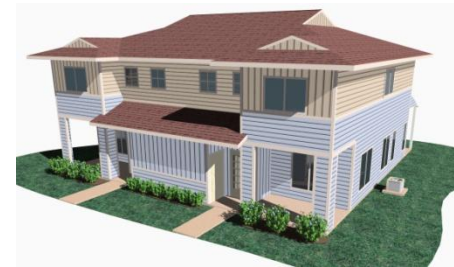
Technology/Design Element	Annual Energy Savings per House*
Passive Ventilation	Up to \$200
Active Ventilation	Increased costs
Window Shading	\$200 - \$400
Radiant Barriers – wall and roof	Could not model
House Coating	Up to \$150
Increased Insulation – walls and roof	Minimal impact
Thermal Mass – ceiling and floor	Minimal impact
Building Orientation	Up to \$150

*All Calculations based on \$0.175/kWhr; Capital costs not included.

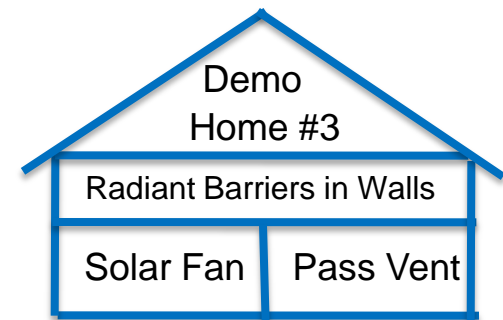
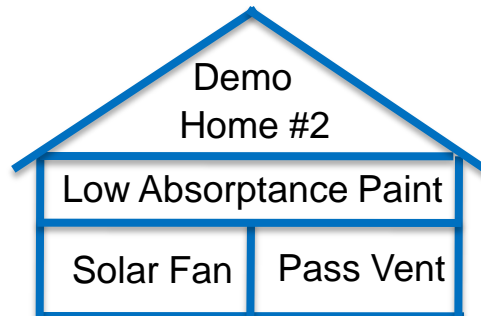
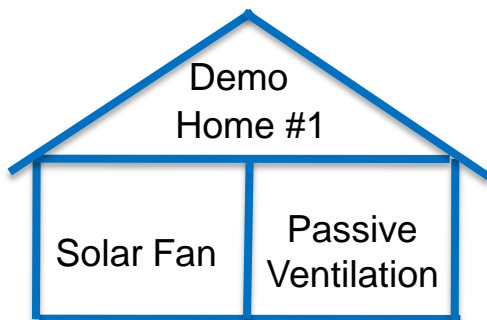
New Construction Demonstration (Duplex)

Demonstration Homes

- Same Street
- Same Orientation
- Similar Family Size



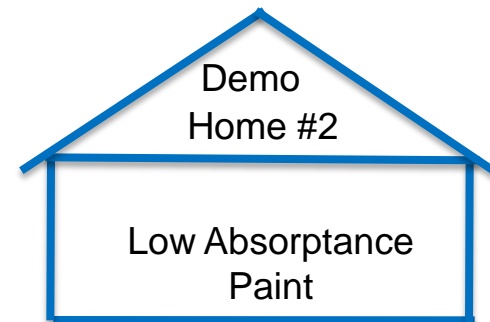
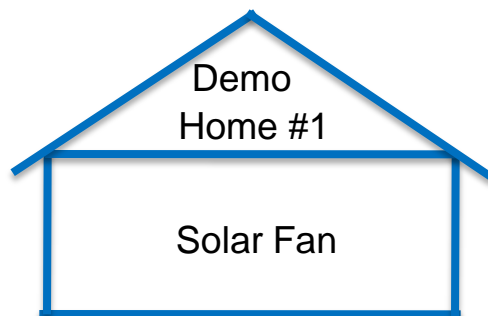
1 Control Home
Standard
Construction



Historical Homes



1 Control Home
Original Construction



Path Forward

- Monitor homes
- Validate overall cost savings (energy savings – technology capital costs)
- Determine energy performance and validate modeling as residential design tool

ZEH Concepts Summary

- The NDCEE's demonstration/validation of innovative technologies is improving the Army standard for military housing
 - Enhancing quality of life for soldiers and their families
 - Supporting the design and construction of sustainable, high-performing buildings
 - Reducing operating costs while achieving sustainability goals
 - Reducing energy and water consumption, air emissions, and construction debris sent to landfills

***Benefits the soldier, the RCI development partner,
and Army stewardship***

Project Stakeholders

- Army Hawaii Family Housing (AHFH)
- Actus Lend Lease
- Schofield Barracks
- Engineer Research and Development Center-
Construction Engineering Research Laboratory (ERDC-
CERL)

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This work was funded through the Office of the Assistant Secretary of the Army (Installations and Environment) and conducted under contract W74V8H-04-D-0005 Task 0440.

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